

CLAIMS

What is claimed is:

1. A method of operating a frequency synthesizer, comprising:
 - detecting a phase difference between an output signal of a controlled oscillator and a reference signal;
 - pumping charge, in response to the phase difference, into a first filter which is configured as a direct path loop filter,
 - pumping charge, in response to the phase difference, into a second filter having substantially the same topology as the first filter, the second filter being configured as an integrating path loop filter; and
 - providing a signal from the first and second filters to the controlled oscillator to control the frequency and phase of the output signal of the controlled oscillator.
2. The method of claim 1 further comprising decoupling the controlled oscillator from the first filter while charge is pumped into the first filter.
3. The method of claim 1 further comprising decoupling the controlled oscillator from the second filter while charge is pumped into the second filter.
4. The method of claim 1 wherein the first filter is a switched capacitor filter.

5. The method of claim 1 wherein the second filter is a switched capacitor filter.
6. The method of claim 5 wherein the switched capacitor filter includes a switched capacitor which is disabled.
7. The method of claim 1 wherein the first filter and the second filter are substantially matched with one another.
8. The method of claim 1 further comprising combining, within the controlled oscillator, an output signal of the first filter with an output signal of the second filter.
9. The method of claim 1 further comprising combining, external to the controlled oscillator, an output signal of the first filter with an output signal of the second filter.
10. The method of claim 1 wherein the controlled oscillator is a voltage controlled oscillator.

11. A frequency synthesizer, comprising:
 - a controlled oscillator;
 - a phase detector that detects a phase difference between an output signal of the controlled oscillator and a reference signal;
 - a charge pump, coupled to the phase detector, that pumps charge at first and second charge pump outputs;
 - a direct path loop filter, coupled to the first charge pump output and the controlled oscillator;
 - an integrating path loop filter, coupled to the second charge pump output and the controlled oscillator, the integrating path loop filter having substantially the same topology as the direct path loop filter;
 - the direct path loop filter and the integrating path loop filter providing a signal to the controlled oscillator to control the frequency and phase of the output signal of the controlled oscillator.
12. The frequency synthesizer of claim 11 wherein the controlled oscillator is decoupled from the direct path loop filter while charge is pumped into the direct path loop filter.
13. The frequency synthesizer of claim 11 wherein the controlled oscillator is decoupled from the integrating path loop filter while charge is pumped into the integrating path loop filter.
14. The frequency synthesizer of claim 11 wherein the direct path loop filter is a switched capacitor filter.

15. The frequency synthesizer of claim 11 wherein the integrating path loop filter is a switched capacitor filter.
16. The frequency synthesizer of claim 15 wherein the switched capacitor filter includes a switched capacitor which is disabled.
17. The frequency synthesizer of claim 11 wherein the direct path loop filter and the integrating path loop filter are substantially matched with one another.
18. The frequency synthesizer of claim 11 wherein the controlled oscillator includes a combiner which combines signals from the direct path loop filter and the integrating path loop filter.
19. The frequency synthesizer of claim 11 further comprising a combiner external to the controlled oscillator which combines signals from the direct path loop filter and the integrating path loop filter.
20. The frequency synthesizer of claim 11 wherein the controlled oscillator is a voltage controlled oscillator.

21. A wireless communication system, comprising:
a frequency synthesizer including:
 a controlled oscillator;
 a phase detector that detects a phase difference between an output signal of the controlled oscillator and a reference signal;
 a charge pump, coupled to the phase detector, that pumps charge at first and second charge pump outputs;
 a direct path loop filter, coupled to the first charge pump output and the controlled oscillator;
 an integrating path loop filter, coupled to the second charge pump output and the controlled oscillator, the integrating path loop filter having substantially the same topology as the direct path loop filter;
 the direct path loop filter and the integrating path loop filter providing a signal to the controlled oscillator to control the frequency and phase of the output signal of the controlled oscillator; and
a mixer circuit, coupled to the frequency synthesizer, to mix an input signal with the output signal of the controlled oscillator of the frequency synthesizer.
22. The wireless communication system of claim 21 wherein the controlled oscillator is decoupled from the direct path loop filter while charge is pumped into the direct path loop filter.
23. The wireless communication system of claim 21 wherein the controlled oscillator is decoupled from the integrating path loop filter while charge is pumped into the integrating path loop filter.

24. The wireless communication system of claim 21 wherein the direct path loop filter is a switched capacitor filter.
25. The wireless communication system of claim 21 wherein the integrating path loop filter is a switched capacitor filter.
26. The wireless communication system of claim 25 wherein the switched capacitor filter includes a switched capacitor which is disabled.
27. The wireless communication system of claim 21 wherein the direct path loop filter and the integrating path loop filter are substantially matched with one another.
28. The wireless communication system of claim 21 wherein the controlled oscillator includes a combiner which combines signals from the direct path loop filter and the integrating path loop filter.
29. The wireless communication system of claim 21 further comprising a combiner external to the controlled oscillator which combines signals from the direct path loop filter and the integrating path loop filter.
30. The wireless communication system of claim 21 wherein the controlled oscillator is a voltage controlled oscillator.

31. A frequency synthesizer integrated circuit (IC) having at least one variable frequency output, comprising:
 - a substrate on which components of the IC are disposed;
 - a controlled oscillator;
 - a phase detector that detects a phase difference between an output signal of the controlled oscillator and a reference signal;
 - a charge pump, coupled to the phase detector, that pumps charge at first and second charge pump outputs;
 - a direct path loop filter, coupled to the first charge pump output and the controlled oscillator;
 - an integrating path loop filter, coupled to the second charge pump output and the controlled oscillator, the integrating path loop filter having substantially the same topology as the direct path loop filter;
 - the direct path loop filter and the integrating path loop filter providing a signal to the controlled oscillator to control the frequency and phase of the output signal of the controlled oscillator.
32. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the controlled oscillator is decoupled from the direct path loop filter while charge is pumped into the direct path loop filter.
33. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the controlled oscillator is decoupled from the integrating path loop filter while charge is pumped into the integrating path loop filter.
34. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the direct path loop filter is a switched capacitor filter.

35. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the integrating path loop filter is a switched capacitor filter.
36. The frequency synthesizer integrated circuit (IC) of claim 35 wherein the switched capacitor filter includes a switched capacitor which is disabled.
37. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the direct path loop filter and the integrating path loop filter are substantially matched with one another.
38. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the controlled oscillator includes a combiner which combines signals from the direct path loop filter and the integrating path loop filter.
39. The frequency synthesizer integrated circuit (IC) of claim 31 further comprising a combiner external to the controlled oscillator which combines signals from the direct path loop filter and the integrating path loop filter.
40. The frequency synthesizer integrated circuit (IC) of claim 31 wherein the controlled oscillator is a voltage controlled oscillator.

41. A frequency synthesizer, comprising:
- a phase detector, the phase detector configured to detect and output a phase difference between two signals;
 - a charge pump coupled to the phase detector, the charge pump configured to derive first and second output signals from the output of the phase detector;
 - a direct path loop filter coupled to the charge pump, the direct path filter configured to filter the first output signal of the charge pump to produce a first filtered signal;
 - an integrating path loop filter coupled to the charge pump, the integrating path loop filter configured to filter the second output signal of the charge pump to produce a second filtered signal, the integrating path loop filter having substantially the same topology as the direct path loop filter; and
 - a combiner coupled to the direct path loop filter and to the integrating path loop filter, the combiner configured to combine the first and second filtered signals.

42. A frequency synthesizer, comprising:
- a phase detector, the phase detector configured to detect and output a phase difference between two signals;
 - a charge pump, coupled to the phase detector, the charge pump configured to derive first and second output signals from the output of the phase detector;
 - a first filter, coupled to the charge pump, configured to filter the first output signal of the charge pump to produce a first filtered signal;
 - a second filter, coupled to the charge pump, configured to filter the second output signal of the charge pump to produce a second filtered signal, the second filter having substantially the same topology as the first filter; and
 - a combiner coupled to the direct path loop filter and to the integrating path loop filter, the combiner configured to combine the first and second filtered signals.
43. The frequency synthesizer of claim 42 wherein the first filter is configured as a direct path loop filter.
44. The frequency synthesizer of claim 42 wherein the second filter is configured as an integrating path loop filter.
45. The frequency synthesizer of claim 42 including a voltage controlled oscillator coupled to the combiner.